US007579783B2

(12) **United States Patent**
Millard et al.

(10) **Patent No.: US 7,579,783 B2**
(45) **Date of Patent: Aug. 25, 2009**

(54) **MICROPROCESSOR-CONTROLLED INSERTABLE FLASHLIGHT ADAPTER DEVICE**

(76) Inventors: **Michael P. Millard**, 265 S. Federal Hwy., #324, Deerfield Beach, FL (US) 33441; **Gary A. Minker**, 7225 Carmine Lake Dr., Lake Worth, FL (US) 33487

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 281 days.

(21) Appl. No.: **11/695,551**

(22) Filed: **Apr. 2, 2007**

(65) **Prior Publication Data**

US 2008/0238342 A1 Oct. 2, 2008

(51) **Int. Cl.**
H05B 37/00 (2006.01)

(52) **U.S. Cl.** ..... **315/200 A**; 315/224; 315/241 P

(58) **Field of Classification Search** ..... 315/200 A, 315/241 P, 224, 240, 241 R, 242, 243
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,498,934 A * 3/1996 Nilssen 315/224

* cited by examiner

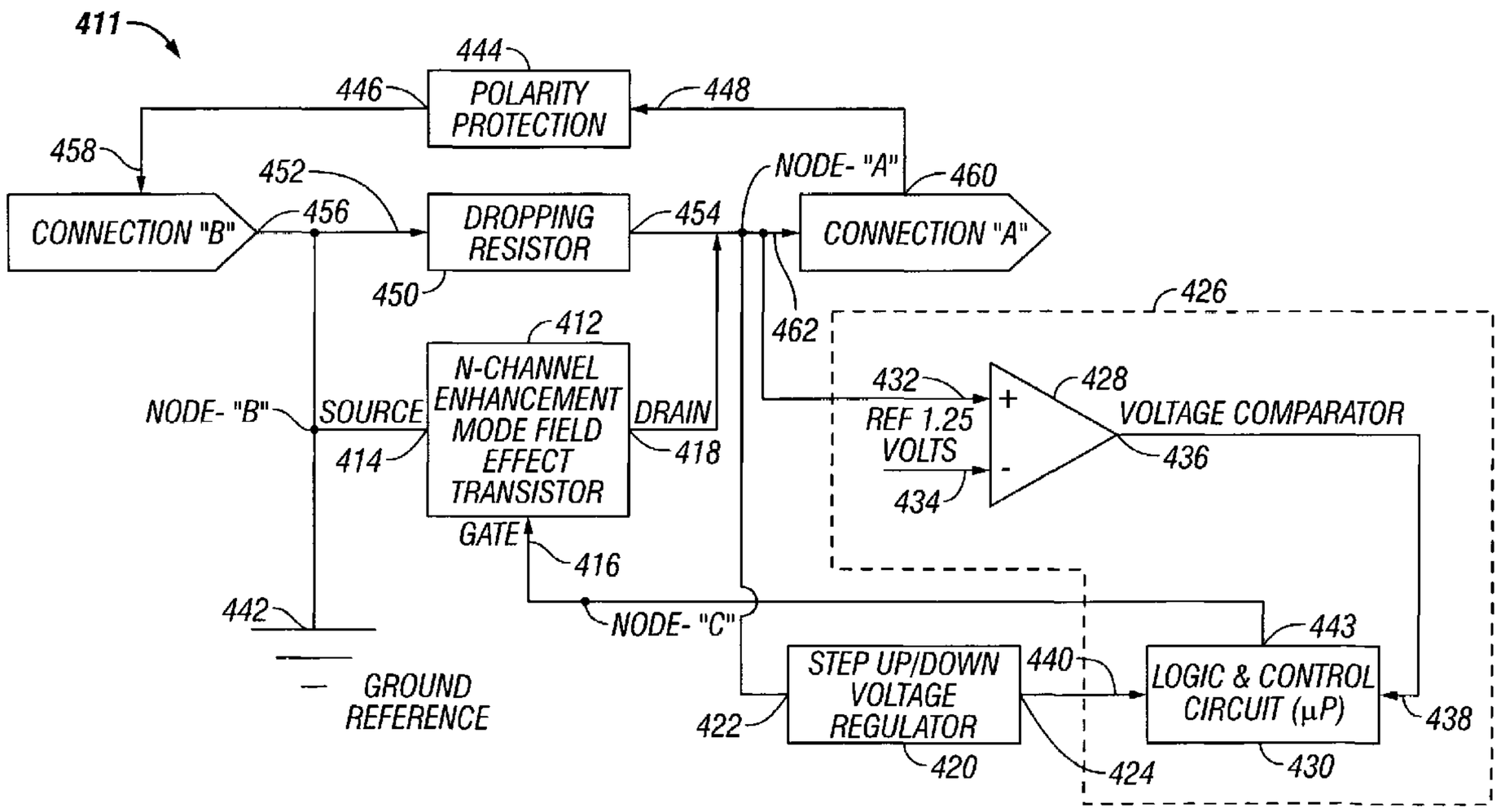
Primary Examiner—David Hung Vu

(74) *Attorney, Agent, or Firm*—Davis M. Chin, Jr.; Davis Chin

(57) **ABSTRACT**

An insertable flashlight adapter device for use in an ordinary flashlight having a lamp includes a disc-like shaped housing unit. Electronic circuitry is disposed within the housing unit for selectively operating the flashlight in at least three different modes. The electronic circuitry has a voltage comparator for determining which one of the at least three different modes the flashlight is being operated. The electronic circuitry also has logic and control means for selectively interrupting current to the flashlight lamp so as to cause the at least three different modes of operation. The logic and control means includes a first timer for monitoring a first time interval between mode changes in the voltage comparator and a second timer for monitoring a second time interval between a power-ON and power-OFF state of the flashlight lamp. As a result, the adapter device has eliminated the need of modifications to make an ordinary flashlight operate selectively in the different modes of operation and to maintain the lifespan of the original ON-OFF switch.

18 Claims, 4 Drawing Sheets



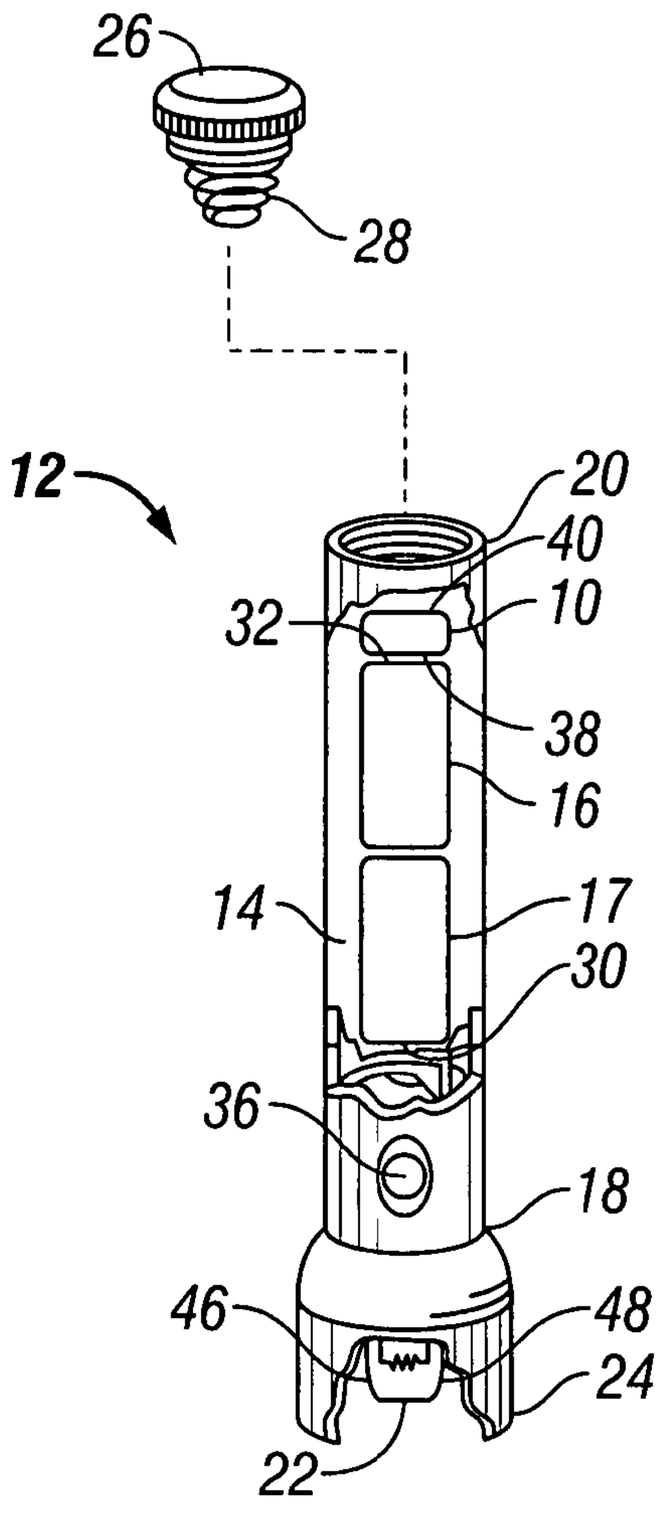


FIG. 1

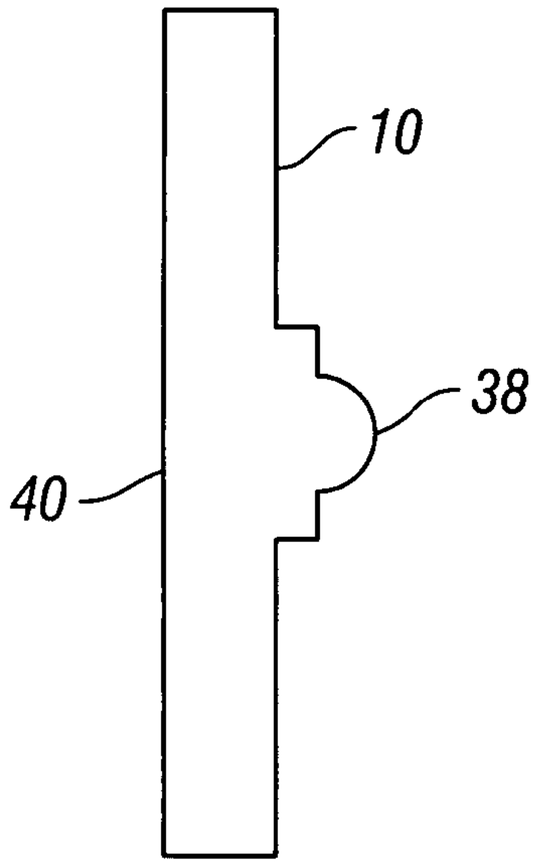


FIG. 2

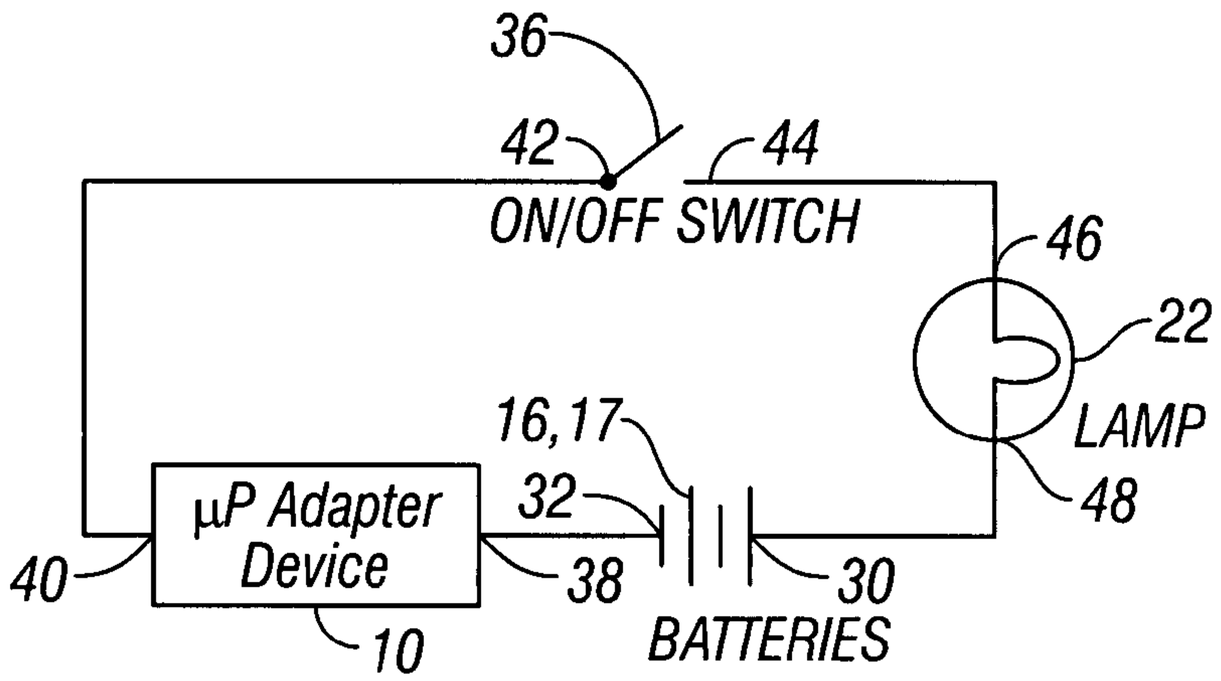


FIG. 3

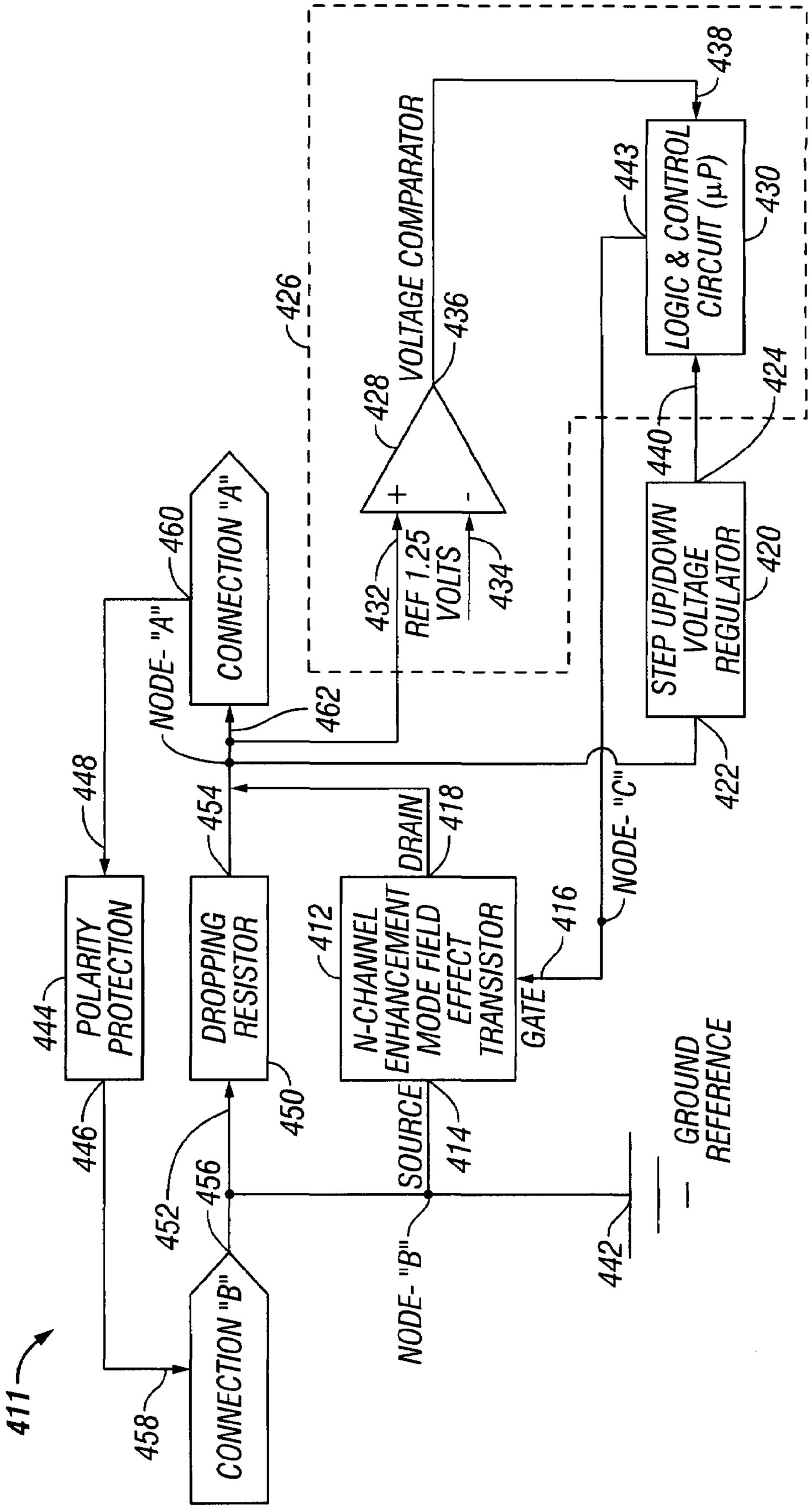

411
426
VOLTAGE COMPARATOR
436
428
438
LOGIC & CONTROL CIRCUIT (µP)
443
430
424
440
STEP UP/DOWN VOLTAGE REGULATOR
420
422
NODE- "C"
416
GATE
DRAIN
418
N-CHANNEL ENHANCEMENT MODE FIELD EFFECT TRANSISTOR
412
SOURCE
414
NODE- "B"
442
GROUND REFERENCE
450
452
456
454
DROPPING RESISTOR
POLARITY PROTECTION
444
446
448
CONNECTION "B"
458
CONNECTION "A"
460
NODE- "A"
462
432
REF 1.25 VOLTS
434
+
-

FIG. 4

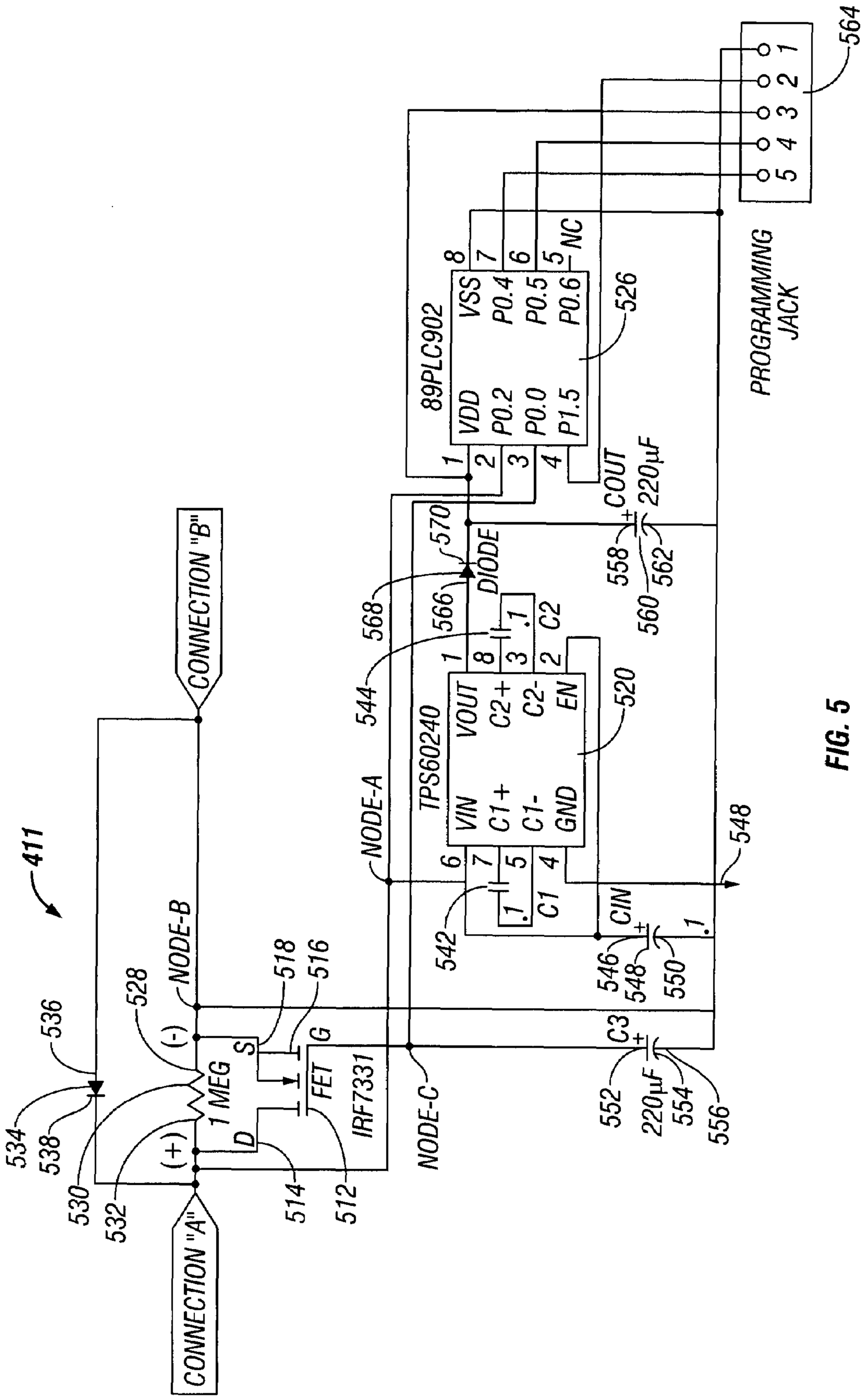

411
564
PROGRAMMING JACK
89PLC902
VSS
P0.4
P0.5
P0.6
NC
526
VDD
P0.2
P0.0
P1.5
COUT
220µF
570
DIODE
568
566
544
558
562
560
TPS60240
VIN
C1+
C1-
GND
VOUT
C2+
C2-
EN
C2
.1
520
NODE-A
542
C1
CIN
546
548
550
548
CONNECTION "B"
NODE-B
518
516
528
536
(-)
(+)
1 MEG
S
D
G
FET
IRF7331
NODE-C
C3
552
220µF
554
556
534
538
530
532
514
512
CONNECTION "A"

FIG. 5

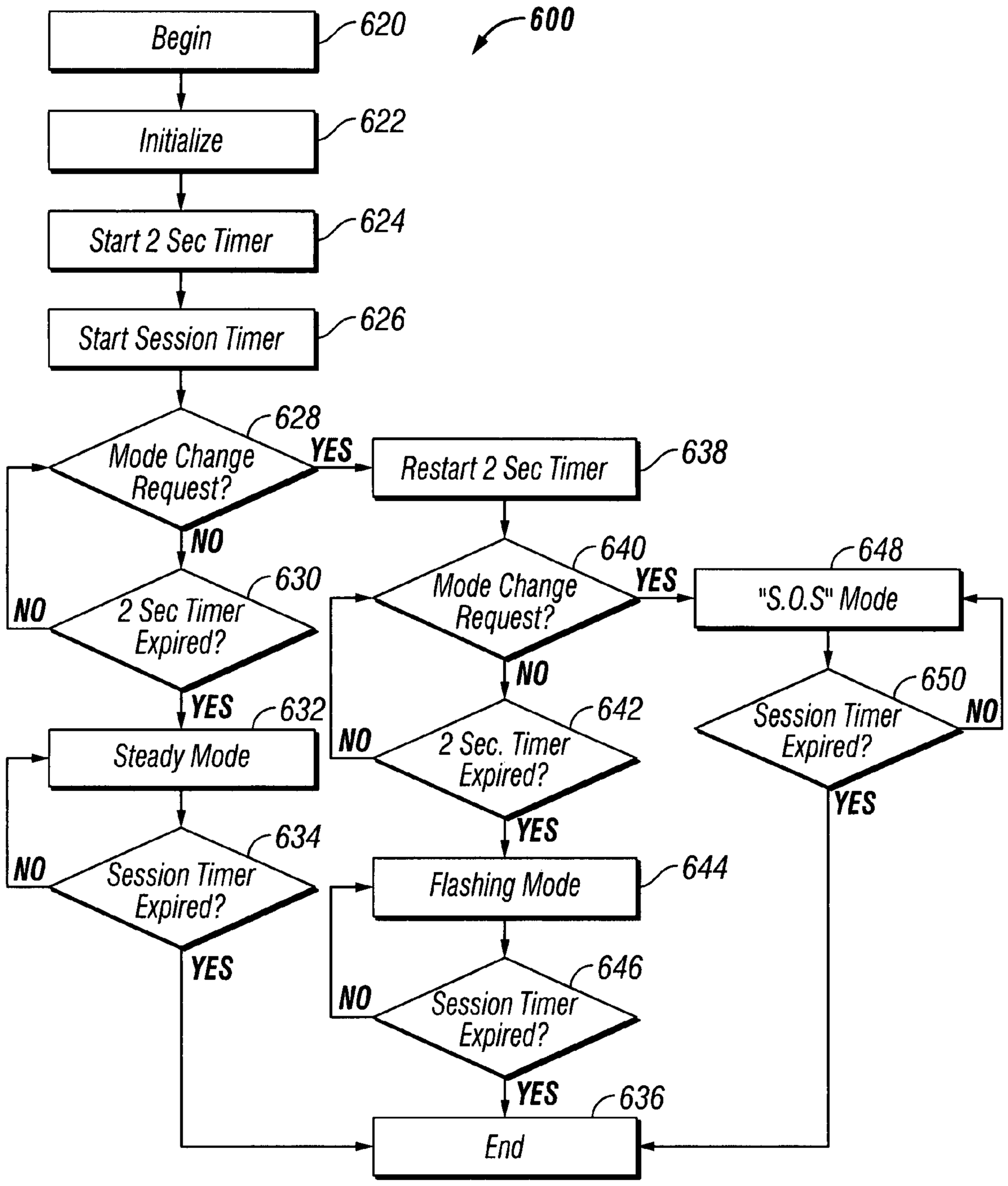

600
Begin
620
Initialize
622
Start 2 Sec Timer
624
Start Session Timer
626
Mode Change Request?
628
YES
NO
Restart 2 Sec Timer
638
2 Sec Timer Expired?
630
NO
YES
Steady Mode
632
Session Timer Expired?
634
NO
YES
Mode Change Request?
640
YES
NO
2 Sec. Timer Expired?
642
NO
YES
"S.O.S" Mode
648
Session Timer Expired?
650
NO
YES
Flashing Mode
644
Session Timer Expired?
646
NO
YES
End
636

FIG. 6

MICROPROCESSOR-CONTROLLED INSERTABLE FLASHLIGHT ADAPTER DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to portable light sources, such as flashlights and the like. More particularly, the invention relates to a microprocessor-controlled insertable flashlight adapter device adapted for use with an ordinary flashlight for selectively operating in at least three different modes.

2. Description of the Prior Art

Ordinary battery-operated flashlights heretofore are generally limited to standard beam-ON and beam-OFF operation under a user's manual activation of a switch. In order to obtain an attention-alerting flashing operation or coded message, such as Morse Coded messages, the user is required to manually activate the flashlight's ON-OFF switch. This action can significantly shorten the life of the ON-OFF switch. In addition, many users may not know Morse Code, or be able to maintain the character and inter-character timing associated with such codes.

While it is possible for a user to manually operate a flashlight's ON-OFF switch to emulate flashing or Morse Code operation, all other known solutions require the replacement of the entire flashlight for a more capable model in order to obtain the multiple modes of operation realized by the present invention.

The prior art has provided various solutions, but all of which require substantial modification of the flashlight body or internal circuitry. As such, the prior art solutions are not universally applicable to the large number of flashlights already manufactured and in use throughout the world.

In view of these problems, attempts have been made heretofore in the prior art to continuously develop new implementations so as to create techniques in which the user can operate the ordinary flashlight in multiple modes of operation without having to manually activate repeatedly, and thus shortening the life of, the ON-OFF switch. Although these improvements may have performed so as to maintain, or even increase, the life of the ON-OFF switch, these improvements inconveniently required adding an additional switch and bulb to the flashlight in order to achieve this goal.

A prior art search directed to the subject matter of this application in the U.S. Patent and Trademark Office revealed the following Letters Patent:

4,703,402
4,835,665
5,091,611
5,321,591
5,667,293
5,671,999
5,909,952

Further, the prior art search also revealed Patent Application Publication Nos. 2004/0246713 dated Dec. 9, 2004 to Kwak and 2005/0128739 dated Jun. 16, 2005 to Sansolo.

U.S. Pat. Nos. 5,909,952 and 5,671,999 both to Guthrie et al. disclosed a flashing identification light adaptor system for a flashlight. In particular, the flashing light adaptor system includes an adaptor housing which is intended to replace the end cap, which includes male threads adapted to mate with the female threads in the barrel of the flashlight. The flashing light adapter housing includes a dedicated switch, a strobe light and a flasher circuit.

Further, there is disclosed in U.S. Pat. No. 5,667,293 to Own a flashlight with illumination and alerting effect comprising of a handle body, a lamp hood and a control circuit. The control circuit is retained within the large step of the handle body and comprises mainly a printed circuit board holder, a printed circuit board, an elastic push button and a connecting element. The printed circuit board is provided with two elastic switches at positions corresponding to the passing holes respectively, and incorporated with a cable connector at its front end, a conductive wire at the rear end. The conductive wire is soldered to a conductive copper plate wall of the sleeve and connected to the positive pole of a battery. The positive pole of the battery connects to the conductive copper plate of the printed circuit board, and its negative pole connects to the handle body made of metallic material. The bulb in the alerting lamp set can be controlled by the printed circuit board at the control circuit to provide either a twinkling effect or a constant lighting effect. The dots on the elastic push button are used to control the elastic switches of the printed circuit board, one for selection of On, Twinkling, or Off modes and the other selection of illumination lamp set or alerting lamp set.

Further, the patent to Cimock et al., U.S. Pat. No. 5,321,591 discloses a flashlight which includes a strobe module. Enclosed in the strobe housing is an integrated circuit board, which incorporates a strobing circuit. The strobing circuit consists of a master transistor and a slave transistor, which form a Darlington circuit, a drain resistor, a resistor, an electrolytic capacitor and a flashlight bulb. Thus, when the strobing circuit is implemented the flashing bulb begins to strobe according to the time constant of the capacitor and the values of resistors in the circuit until the batteries are disconnected from the circuit.

The remaining patents, listed above but not specifically discussed, are deemed to be only of general interest and show the state of the art in battery-operated flashlights.

Therefore, it should come as no surprise that designers in the industry have been developing and constructing a more efficient way to adapt an ordinary flashlight into a flashing flashlight heretofore in the prior art so as to maintain the lifespan of the original ON-OFF switch. In spite of these efforts in the prior art, it would be still desirable to provide a microprocessor-controlled insertable flashlight adapter device for use in a flashlight so as to limit the amount of modifications, to the body or circuitry of the original flashlight, required to make the flashlight selectively operate in at least three different modes and to maintain the lifespan of the original ON-OFF switch.

None of the prior art discussed above discloses a microprocessor-controlled insertable flashlight adapter device like that of the present invention which eliminates the burdensome modifications needed to make an original flashlight selectively operate in at least three different modes.

SUMMARY OF THE INVENTION

Accordingly, it is a general object of the present invention to provide a microprocessor-controlled insertable flashlight adapter device for an ordinary flashlight which facilitates an easy means for a flashlight operator to create a steady beam, a flashing light or "SOS"-style message without fatiguing the operator, or causing adverse wear to the flashlight's existing ON-OFF switch.

It is an object of the present invention to provide a microprocessor-controlled insertable flashlight adapter device for an ordinary flashlight which interrupts the current to the bulb of an ordinary flashlight such that flashing of the beam may occur at regular intervals without the need for the flashlight operator to continuously operate the flashlight switch.

It is another object of the present invention to provide a microprocessor-controlled insertable flashlight adapter device for an ordinary flashlight which interrupts the current to the bulb of an ordinary flashlight such that the flashing of the beam occurs at internationally recognized character coded sequences, such as Morse Code "S-O-S" style messages.

It is still another object of the present invention to provide a microprocessor-controlled insertable flashlight adapter device for an ordinary flashlight which is housed in series with the existing battery or batteries in the body of the ordinary flashlight.

In a preferred embodiment of the present invention, there is provided an insertable flashlight adapter device for use in an ordinary flashlight having a lamp which includes a disc-like shaped housing unit. Electronic circuitry is disposed within the housing unit for selectively operating the flashlight in at least three different modes. The electronic circuitry has a voltage comparator for determining which one of the at least three different modes the flashlight is being operated.

The electronic circuitry also has logic and control means for selectively interrupting current to the flashlight lamp so as to cause the at least three different modes of operation. The logic and control means includes a first timer for monitoring a first time interval between mode changes in the voltage comparator and a second timer for monitoring a second time interval between a power-ON and power-OFF state of the flashlight lamp. As a result, the adapter device has eliminated the need of modifications to make an ordinary flashlight operate selectively in the different modes of operation and to maintain the lifespan of the original ON-OFF switch.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects and advantages of the present invention will become more fully apparent from the following detailed description when read in conjunction with the accompanying drawings with like reference numerals indicating corresponding parts throughout, wherein:

FIG. **1** is an exploded view of an ordinary flashlight, showing the implementation of a microprocessor-controlled insertable flashlight adapter device constructed in accordance with the principles of the present invention;

FIG. **2** is a side view of the microprocessor-controlled insertable flashlight adapter device;

FIG. **3** is a simplified electrical schematic diagram of the microprocessor-controlled insertable flashlight adapter device of FIG. **2** in use with an ordinary flashlight;

FIG. **4** is a general block diagram of the electronic circuitry housed within the microprocessor-controlled insertable flashlight adapter device;

FIG. **5** is a detailed electrical schematic circuit diagram of the electronic circuitry of FIG. **4**; and

FIG. **6** is a flow chart diagram, illustrating the different modes of operation when the microprocessor-controlled insertable flashlight adapter device is in use with an ordinary flashlight.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

It is to be distinctly understood at the outset that the present invention shown in the drawings and described in detail in conjunction with the preferred embodiments is not intended to serve as a limitation upon the scope or teachings thereof, but is to be considered merely as an exemplification of the principles of the present invention.

Referring now in detail to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, there is illustrated in FIGS. **1** through **5** a preferred embodiment, constructed in accordance with the principles of the present invention.

FIG. **1** illustrates a multi-cell tubular flashlight **12**, similar to the many flashlights already manufactured and in service throughout the world, in use with the microprocessor-controlled insertable flashlight adapter device **10** of the present invention. The flashlight includes a spring-loaded tubular cell compartment **14** which accommodates a number of cells **16**, **17** placed end to end in electrical series. The cells **16**, **17** extend substantially from a first end **18** to a second end **20** of the cell compartment **14**. When placed within the cell compartment **14**, the cells **16**, **17** are positioned in such a manner so that a positive terminal **30** of each cell is directed toward the first end **18** of the cell compartment **14** and a negative terminal **32** of each cell is directed toward the second end **20**.

A lamp bulb **22** having a negative terminal or contact **46** and a positive terminal or contact **48** is located at the first end **18** within a flashlight head **24**. A removable tail cap **26** is located at the second end **20** and contains a spring **28**. Once the tail cap **26** is secured to the second end **20** of the cell compartment **14**, the spring **28** of the tail cap **26** is engaged with the negative terminal **32** of the cell **16**. An ON-OFF switch **36**, having a first end **42** and a second end **44**, selectively couples the negative terminal **32** of the cells to the negative terminal **46** of the lamp bulb **22**.

Up to this point, a conventional flashlight **12** has been described in order to show the adapter device **10** of the present invention in use with the flashlight. Thus, it should be obvious to one skilled in the art that any functional flashlight could also be used with the present invention.

Continuing along, the adapter device **10** is inserted within the cell compartment **14**, and in between the negative terminal **32** of the cell **16** and the spring **28** of the tail cap **26**. As shown in FIG. **2**, the adapter device **10** includes a positive terminal **38** and a negative terminal **40**. Once positioned within the flashlight compartment **14**, the positive terminal **38** of the adapter device **10** is in contact with the negative terminal **32** of the cell **16** and the negative terminal **40** of the adapter device is coupled with the first end **42** of the ON-OFF switch **36** via the spring **28** (FIG. **1**).

However, it should be noted that the adapter device **10** may be placed at any position within the cell compartment **14** as long as the adapter device **10** is in series appropriately with the cells **16**, **17**. The adapter device **10** is designed to approximate the cross-sectional diameter of trade size primary cells (batteries), particularly C-size or D-size cells. The adapter device **10** includes a housing unit which is preferably formed of a generally flat disc-like configuration. The adapter device **10** is approximately a quarter inch thick and houses electronic logic and control circuitry **411** (shown in FIGS. **4** and **5**),

which selectively activates the different modes of operation when inserted into the standard flashlight **12**.

Referring now to FIG. **3**, a simplified electrical schematic diagram of the microprocessor-controlled insertable flashlight adapter device **10** adapted for use within an ordinary flashlight is illustrated. In particular, there is shown the ON-OFF switch **36**, the lamp bulb **22**, the multiple cells **16**, **17** and the adapter device **10** of the present invention all connected in series. The first end **42** of ON-OFF switch **36** is connected to the negative terminal **40** of the adapter device **10**. The positive terminal **38** of the adapter device **10** is connected to the negative terminal **32** of the cell **16**. Progressing through the circuit, it can be seen that the positive terminal **30** of the cell **17** is connected to the positive contact **48** of the lamp bulb **22**. Finally, the negative contact **46** of lamp bulb **22** is connected to the second end **44** of the ON-OFF switch **36**.

FIG. **4** is a general block diagram of the electronic circuitry **411** housed within the insertable flashing adapter device **10** of FIG. **2**. The electronic circuitry **411** includes an N-Channel Enhancement Mode Field Effect Transistor (FET) **412** having a drain **418**, a gate **416** and a source **414**; a step up/down voltage regulator **420** having an input **422** and an output **424**; and a processing unit **426** consisting of a voltage comparator **428** and a logic and control circuit (microprocessor) **430**. The step up/down voltage regulator **420** may be incorporated into one integrated circuit chip, such as one similar to the commercially available Texas Instruments TPS60240 chip (as shown in FIG. **5**). Along the same lines, the processing unit **426** may also be incorporated into one integrated circuit chip, such as one similar to the commercially available Phillips Electronics P89LPC902 8-bit microcontroller (as shown in FIG. **5**).

The voltage comparator **428** is formed of an operational amplifier having a non-inverting input **432**, an inverting input **434** and an output **436**. While the non-inverting input **432** of the voltage comparator is connected to a node A, the inverting input **434** is connected to a reference voltage **444** having a value of approximately +1.25 volts. The microprocessor **430** has a first input **438**, which is connected to the output **436** of the voltage comparator **428**; a second input **440**, which is connected to the output **424** of the voltage regulator **420**; and an output **443**, which is connected to the gate **416** of the FET **412**. The input **422** of the voltage regulator **420** is connected to the node A.

The electronic circuitry **411** of FIG. **4** also includes a polarity protection component **444** having a first end **446** and a second end **448**, and a dropping resistor **450** having a first end **452** and a second end **454**. The source **414** of the FET **412** is coupled to a ground reference **442** via a node B. The drain **418** of the FET is connected to node A. The first end **452** of the dropping resistor **450** is coupled to a first end **456** of a connection terminal B via node B. The second end **454** of the resistor **450** is connected to node A. A second end **458** of terminal B is connected to the first end **446** of polarity protection component **444**. The second end **448** of polarity protection component **444** is connected to a first end **460** of a connection terminal A. A second end **462** of terminal A is connected to node A.

FIG. **5** is a detailed electrical schematic circuit diagram of the electronic circuitry **411** of FIG. **4**. The electronic circuitry **411** includes an N-Channel Enhancement Mode Field Effect Transistor (FET) **512** having a drain **514**, a gate **516** and a source **518**; a step up/down voltage regulator **520**; and a processing unit **526** (including the voltage comparator **428** and the microprocessor **443** of FIG. **4**). The source **518** of the FET **512** is connected to a first end **528** of a resistor (R**1**) **530** and to a ground potential **540** via a node B. The drain **514** of the FET **512** is connected to a second end **532** of resistor **530**. The gate **516** of FET **512** is connected to a node C. The node C is connected to pin **3** of the processing unit **526** and is also connected to a first end **552** of a holding capacitor (C**3**) **554**. A second end **556** of the holding capacitor **554** is connected to the ground potential **540**.

The electronic circuitry **411** also includes a first diode **534** (polarity protection component **444** of FIG. **4**) having an anode **536** connected to the node B and a cathode **538** connected to node A. A terminal connection B is coupled to the ground potential **540** via the node B. A terminal connection A is coupled to pin **6** of the voltage regulator **520** via the node A and is also coupled to pin **2** of the processing unit **526**.

A flying capacitor (C**1**) **542** is placed across pins **7** and **5** of the voltage regulator **520**. Another flying capacitor (C**2**) **544** is placed across pins **8** and **3** of the voltage regulator **520**. Pin **4** of the voltage regulator **520** is connected to the ground potential **540**. Pin **1** of the voltage regulator **520** is connected to an anode **566** of a second diode **568**. A cathode **570** of the second diode **568** is connected to pin **1** of the processing unit **526** and to a first end **558** of a supply capacitor (Cout) **560**. A second end **562** of capacitor **560** is connected to the ground potential **540**. Pins **2** and **6** of the voltage regulator are coupled to a first end **546** of an input capacitor (Cin) **548**. A second end **550** of the input capacitor **548** is connected to the ground potential **540**.

A programming jack **564** is used to program the microprocessor of the processing unit **526**. Pin **1** of the programming jack **564** is coupled to pin **8** of the processing unit **526** and the ground potential **540**. Pin **2** of the programming jack **564** is connected to pin **4** of the processing unit **526**. Pin **3** of the programming jack **564** is connected to pin **1** of the processing unit **526**. Pin **4** of the programming jack **564** is connected to pin **6** of the processing unit **526**. Pin **5** of the programming jack **564** is connected to pin **7** of the processing unit **526**.

With reference to FIGS. **4** and **5**, the operation of the electronic circuitry **411** will now be described in detail. At the outset, it will be noted that the dropping resistor **450** (**530**) is connected in-series with the flashlight lamp bulb **22** via the terminal connections A and B. The dropping resistor **530** functions as a current limiter so as to restrict the flow of current which effectively prevents the flashlight lamp bulb **22** from being illuminated. When the user initially activates the ON-OFF switch **36** of the flashlight, an insufficient amount of current will flow so to cause the flashlight lamp bulb **22** to remain extinguished due to the dropping resistor **530**.

However, the dropping resistor **530** will establish a voltage that is stored in the input capacitor **548** to supply power to the step-up/down voltage regulator **420** (**520**), which, in turn, provides power to the logic and control circuit **430** of the processing circuit **426**. This resistor voltage is also provided to the voltage comparator **428** of the processing unit **426**. The voltage comparator **428** is used to compare the voltage on resistor **530** with the reference voltage of +1.25 volts generated from within the logic and control circuit **430**.

The FET **412** (**512**) having a gate controlled by the logic and control circuit **430** is connected in parallel with the dropping resistor **530**. When the FET **512** is turned "ON" under the control of the circuit **430**, the small on-resistance of the FET will be connected in parallel with the dropping resistor **530** so as to effectively create a short circuit. This allows sufficient current to flow in order to cause the flashlight lamp bulb **22** to be lighted. When the FET **512** is rendered conductive, the lamp bulb **22** will shine at a slightly reduced intensity than when the adapter device **10** of the present invention is not used due to the small on-resistance of the FET **512**.

The step-up/down voltage regulator **520** is preferably a switched capacitor buck-boost converter design utilizing two internal voltage charge pumps. The flying capacitors **542** and **544** are required for the proper operation of the internal voltage charge pumps. The polarity protection diode **534** is connected in a reversed bias manner across the terminal connection A and B in order to protect the electronic circuitry **411** when it is accidentally inserted improperly into the flashlight battery cell compartment **14**. If either of the batteries **16**, **17** or the adapter device **10** is installed with the incorrect polarity, the polarity protection diode will allow current to bypass the electronic circuitry **411** so as to protect it from being damaged. However, in this situation, the brightness of the lamp bulb **22** will be noticeably reduced due to the voltage drop across the polarity protection diode **534** being forward biased.

The supply capacitor **560** serves to hold a charge for maintaining proper operation of the logic and control circuit **430** during the time periods when the FET **512** is rendered conductive. This supply capacitor **560** is required since the shorting of the dropping resistor **530** will cause the input voltage on the supply capacitor **548** to collapse, thereby rendering inoperative the step-up/down voltage regulator **420** (**520**) and eventually, the processing circuit **426** (**526**).

The current being drawn from the supply capacitor **560** is minimized by causing the logic and control circuit **430** to enter "Idle" or "Shutdown" modes until the next activity of the FET **512** is required. When the step-up/down voltage regulator **520** is rendered inoperative, the second diode **568** is used to block the discharge path, thereby preventing discharge of the supply capacitor **560** through the step-up/down voltage regulator **520**.

The logic and control circuit **430** is used to interrupt the current to the lamp bulb **22** by sequentially activating and deactivating the FET **512** in accordance with the relevant stored time intervals. The circuit also monitors the status of the flashlight's ON-OFF switch **36**, and estimates the run time of current mode of operation of the flashlight via two internal timers. In particular, the logic and control circuit **430** monitors the status of the flashlight's ON-OFF switch **36** by sampling the input voltage on pin **6** of the step-up/down voltage regulator **520**.

The logic and control circuit **430** determines whether a mode change request has been issued by indirectly monitoring the position of the flashlight's ON-OFF switch **36**. However, this is performed only after the circuit **430** has caused the FET **512** to be rendered non-conductive. When the presence of a significant amount of voltage across the parallel-connected FET **512** and dropping resistor **530** is detected on the non-inverting input **432** of the comparator **428**, the output **436** thereof will be at a high or logic "1" state which indicates that the flashlight switch **36** is in the "CLOSED" condition. Similarly, when no significant voltage is detected across the parallel-connected FET **512** and dropping resistor **530** on the non-inverting input **432**, the output **436** of the comparator **428** will be at low or logic "0" state which indicates that the flashlight switch **36** is in the "OPEN" condition.

A short timing subroutine stored within the logic and control circuit **430** functions to debounce all switch activations, and if needed as determined by the current operating mode, it will discharge the holding capacitor **554** so as to allow for accurate input conditions to the voltage comparator **520**. Finally, the status of the flashlight's ON-OFF switch **36** as mentioned above is compared with the reference voltage by the voltage comparator **428** in order to determine which of three different modes of operation, i.e. a steady beam mode, a flashing beam mode, or a Morse Coded "SOS" style beam mode, is being requested.

Referring to FIG. **6**, a flow chart diagram illustrates the different modes (steady, flashing, and "S.O.S.") of operation when the insertable flashing adapter device is inserted for use within an ordinary flashlight. The flow chart starts with BEGIN block **620**. BEGIN block **620** includes the step of the flashlight user engaging the ON-OFF switch to the ON position. This first switching of the ON-OFF switch to ON will not illuminate the flashlight bulb because current will not flow due to the action of the dropping resistor **530** (FIG. **5**). BEGIN block **620** then proceeds to INITIALIZE block **622**. INITIALIZE block **622** includes the process of the step up/down voltage regulator **520** establishing a charge onto the supply capacitor **560** (FIG. **5**) sufficient to operate the logic circuit **430** (FIG. **4**), which will commence execution of the programmed instructions.

INITIALIZE block **622** continues onto START 2 SEC TIMER block **624** where the first clock, a two-second timer, is initialized. START 2 SEC TIMER block **624** continues onto START SESSION TIMER block **626** where the second clock, a session timer having a predetermined duration, such as 10 minutes, is initialized.

Once the clocks are initialized, the process then proceeds to MODE CHANGE REQUEST decision block **628**. Here, while the two-second timer is running, the logic circuit **430** will check the voltage comparator **428** (FIG. **4**) output for a state change. A state change is implemented by the user toggling the ON-OFF switch prior to the expiration of the two-second timer. If no state change is detected, the MODE CHANGE REQUEST block **628** proceeds to a 2 SEC TIMER EXPIRED? decision block **630**. If the two-second timer has not expired, then the process loops back to the MODE CHANGE REQUEST decision block **628**. If the two-second timer has expired, then the 2 SEC TIMER EXPIRED? block **630** advances to the STEADY MODE block **632**.

In the STEADY MODE block **632**, the holding capacitor **554** (FIG. **5**) will charge so that the logic circuit **430** will enter an idle state while not affecting the ON status of the FET **512**. In other words, the flashlight will operate in a steady mode and maintain a constant beam of light.

Moving along, the STEADY MODE block **632** proceeds to the SESSION TIMER EXPIRED? decision block **634**. If the session timer does not expire, then the step loops back to the STEADY MODE block **632** and the flashlight continues to operate in the steady mode. However, if the session time does expire, the process step advances to the END block **636**. Once the session timer expires, the logic circuit **430** will disable the FET **512**. The disabled FET **512** effectively deactivates the flashlight regardless of the position of the ON-OFF switch.

Going back to MODE CHANGE REQUEST decision block **628**, if a state change is detected, because the user has toggled the ON-OFF switch, then the block proceeds to RESTART 2 SEC TIMER block **638**. Once the two-second timer is restarted, the process then advances to MODE CHANGE REQUEST decision block **640**. Here, while the two-second timer is running, the logic circuit **430** will check the voltage comparator **428** (FIG. **4**) output for a state change. If no state change is detected, the MODE CHANGE REQUEST block **640** proceeds to a 2 SEC TIMER EXPIRED? decision block **642**. If the two-second timer has not expired, then the process loops back to the MODE CHANGE REQUEST decision block **640**. If the two-second timer has expired, then the 2 SEC TIMER EXPIRED? block **642** advances to the FLASHING MODE block **644**.

In the FLASHING MODE block **644**, the logic circuit **430** interrupts the flashlight bulb current by sequentially activating and deactivating the FET **512** according to the relevant time interval stored in the logic circuit **430**. In other words, the flashlight will operate in a flashing mode and will flash at a constant interval.

Moving along, the FLASHING MODE block **644** proceeds to the SESSION TIMER EXPIRED? decision block **646**. If the session timer does not expire, then the step loops back to the FLASHING MODE block **644** and the flashlight continues to operate in the flashing mode. However, if the session time does expire, the step advances to the END block **636**. Once the session timer expires, the logic circuit **430** will disable the FET **512**. The disabled FET **512** effectively deactivates the flashlight regardless of the position of the ON-OFF switch.

Going back to MODE CHANGE REQUEST decision block **640**, if a state change is detected, because the user has toggled the ON-OFF switch, then the block proceeds to S.O.S. MODE block **648**. In the S.O.S. MODE block **648**, the logic circuit **430** interrupts the flashlight bulb current by sequentially activating and deactivating the FET **512** according to the relevant time interval stored in the logic circuit **430**. In other words, the flashlight will operate in an S.O.S. mode and will flash at an interval that corresponds to the Morse code for S.O.S.

Finally, the S.O.S. MODE block **648** proceeds to the SESSION TIMER EXPIRED? decision block **650**. If the session timer does not expire, then the step loops back to the S.O.S. MODE block **648** and the flashlight continues to operate in the S.O.S. mode. However, if the session time does expire, the process step advances to the END block **636**. Once the session timer expires, or if the user turns off the flashlight, the logic circuit **430** will commence operation as if no mode had been previously selected.

It should be understood that upon expiration of any two-second timer, the logic circuit **430** will no longer search for state changes, and instead, will operate the FET **512** according to the mode selected until expiration of the session timer or until the user turns off the flashlight.

From the foregoing detailed description, it can thus be seen that the present invention provides a more efficient and effective way to adapt an ordinary flashlight for selectively operating in three different modes but yet maintains the lifespan of the original ON-OFF switch. As a result, the adapter device of the present invention eliminates the burdensome modifications needed to make an original flashlight operate selectively in a steady beam, a flashing light, or "S.O.S." mode without adversely affecting the lifespan of the original ON-OFF switch.

While there has been illustrated and described what is at present considered to be a preferred embodiment of the present invention, it will be understood by those skilled in the art that various changes and modifications may be made, and equivalents may be substituted for elements thereof without departing from the true scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the central scope thereof. Therefore, it is intended that this invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out the invention, but that the invention will include all embodiments falling within the scope of the appended claims.

The invention claimed is:

1. An insertable flashlight adapter device for use in an ordinary flashlight having a lamp, comprising:

a disc-like shaped housing unit;

electronic circuit means disposed within said housing unit for selectively operating the flashlight in at least three different modes;

said electronic circuit means having voltage comparator means for determining which one of the at least three different modes the flashlight is being operated;

said electronic circuit means having logic and control means for selectively interrupting current to the flashlight lamp so as to cause the at least three different modes of operation; and

said logic and control means having first timing means for monitoring a first time interval between mode changes in said voltage comparator means and second timing means for monitoring a second time interval between a power-ON and power-OFF state of said flashlight lamp.

2. An insertable flashlight adapter device as claimed in claim **1**, wherein said disc-like shaped housing unit is of a size approximating the cross-sectional diameter of a standard C-sized battery.

3. An insertable flashlight adapter device as claimed in claim **1**, wherein said disc-like shaped housing unit is of a size approximating the cross-sectional diameter of a standard D-sized battery.

4. An insertable flashlight adapter device as claimed in claim **1**, wherein said at least three different modes include a steady beam mode, a flashing mode and an "S.O.S." Morse coded message mode.

5. An insertable flashlight adapter device as claimed in claim **2**, wherein said housing unit is arranged in series with the standard battery.

6. An insertable flashlight adapter device as claimed in claim **1**, wherein said electronic circuit means further includes a field effect transistor which is activated and deactivated so as to interrupt the current to the flashlight lamp.

7. An insertable flashlight adapter device as claimed in claim **1**, wherein said electronic circuit means further includes polarity protection means for protecting against improper insertion of said flashlight adapter device into said flashlight.

8. An insertable flashlight adapter device as claimed in claim **7**, wherein said polarity protection means includes a diode.

9. An insertable flashing adapter as claimed in claim **1**, wherein said electronic circuit means further includes current limiting means for restricting flow of current to effect incandescence of the flashlight lamp.

10. In an ordinary flashlight, comprising, in combination:

a lamp bulb;

ON-OFF switching means for powering said flashlight;

said flashlight having compartment means for receiving a power supply;

a disc-like shaped housing unit;

electronic circuit means disposed within said housing unit for selectively operating the flashlight in at least three different modes;

said electronic circuit means having polarity protection means for protecting against improper insertion of an adapter device into said flashlight; and

said housing unit being in electrical series with said power supply, said lamp bulb and said ON-OFF switching means for powering said flashlight lamp.

11. In an ordinary flashlight as claimed in claim **10**, wherein said disc-like shaped housing unit is of a size approximating the cross-sectional diameter of a standard C-sized battery.

12. In an ordinary flashlight as claimed in claim **10**, wherein said disc-like shaped housing unit is of a size approximating the cross-sectional diameter of a standard D-sized battery.

13. In an ordinary flashlight as claimed in claim **10**, wherein said at least three different modes include a steady beam mode, a flashing mode and an "S.O.S." Morse coded message mode.

14. In an ordinary flashlight as claimed in claim **11**, wherein said housing unit is arranged in series with the standard battery.

15. In an ordinary flashlight as claimed in claim **10**, wherein said electronic circuit means includes a field effect transistor which is activated and deactivated so as to interrupt current to the flashlight lamp.

16. In an ordinary flashlight as claimed in claim **10**, wherein said polarity protection means includes a diode.

17. In an ordinary flashlight as claimed in claim **10**, wherein said electronic circuit means further includes current limiting means for restricting flow of current to effect incandescence of the flashlight lamp.

18. A method for using an adapter device to selectively operate a flashlight in at least three different modes of operation, said method comprising the steps of:

providing electronic circuitry in the adapter device to selectively operate the flashlight in the at least three different modes of operation;

providing the electronic circuitry to include polarity protection to protect against improper insertion of the adapter device into the flashlight;

activating firstly an ON-OFF switch to cause a steady beam mode of operation;

activating secondly the ON-OFF switch to cause a flashing mode of operation; and

activating thirdly the ON-OFF switch to cause an "S.O.S." Morse coded message mode of operation.

* * * * *